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The need for a new Denver Mint was reviewed following a request by the Bureau of the Mint for \$65 million to construct a new mint on the basis that coin demand was increasing. Four different models were used to forecast future coin requirements. Findings/Conclusions: Coin requirements for 1990 range from 17 to 50 billion coins, depending on the forecast model used. The most likely estimate of coin requirements for 1990 is about 41.5 billion coins. About 90 percent of that amount, or 37.6 billion coins, is pennies. In 1990, it will cost about 10.25 cents to add one cent into circulation because of projected increases in demand for copper cents, cent manufacturing and distribution costs, copper prices, and cent attrition rates. The Bureau's estimate of construction costs for a new Denver mint may be too high because: space requirements appear overstated; construction costs were based on Philadelphia Mint construction and include features not needed by the Denver Mint; and escalation for inflation appears to be duplicated. Recommendations: Facility changes such as opening the San Francisco Assay Office to production of general circulation coinage, combining functions and renovating space to make more space available for coinmaking machines, and relying on commercial supplies for coinage metals are suggested as alternatives to the proposed expenditure for a new mint. (RRS)

00268

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**REPORT TO THE SENATE
COMMITTEE ON BANKING, HOUSING,
AND URBAN AFFAIRS**

**BY THE COMPTROLLER GENERAL
OF THE UNITED STATES**



**Alternatives To Constructing
A New Denver Mint**

Bureau of the Mint

RELEASED
12/14/76

The Bureau of the Mint asked the Congress for \$65 million to construct and equip a new U.S. Mint in Denver. The Bureau asked for this because demand for coins is continuing to increase and soon will exceed the coinmaking capacity of its mints.

The Bureau of the Mint has several options available to make better use of its facilities and consequently increase its coinmaking capacity. In light of the uncertainty associated with projecting coin requirements and possible changes in the present U.S. coinage system due to rising coin production and distribution costs, these options are, at this time, a better alternative to increase production than is the proposed expenditure for a new mint structure.



COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

B-114877

The Honorable William Proxmire
Chairman, Committee on Banking, Housing,
and Urban Affairs
United States Senate

Dear Mr. Chairman:

This is in response to your Committee's March 2 and March 25, 1976, letters requesting that we review the need for a new Denver Mint, report on any options open to the Mint for meeting its production needs, and evaluate the reasonableness of the construction cost estimate prepared in connection with the proposed mint.

We invite your attention to the fact that this report contains recommendations to the Secretary of the Treasury which are set forth on page 38. As you know, section 236 of the Legislative Reorganization Act of 1970 requires the head of a Federal agency to submit a written statement on actions taken on our recommendations to the House and Senate Committees on Government Operations not later than 60 days after the date of the report and to the House and Senate Committees on Appropriations with the agency's first request for appropriations made more than 60 days after the date of the report. We will be in touch with your office in the near future to arrange for release of the report so that requirements of section 236 can be set in motion.

At the request of your office, we solicited written comments on our report from Department of Treasury officials. Their comments have been incorporated in the report.

Sincerely yours,

A handwritten signature in black ink, appearing to read "James B. Stuckey".

Comptroller General
of the United States

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ABBREVIATIONS

GAO	General Accounting Office
GSA	General Services Administration
RTI	Research Triangle Institute

D I G E S T

The Secretary of the Treasury is charged by the Congress with responsibility for making adequate numbers of coins to meet national needs. The Bureau of the Mint, established to manufacture coins, now has a planned coin-making capacity of about 18.1 billion coins a year in three production facilities. In fiscal year 1975 it produced about 13.1 billion coins to meet demands.

The Bureau is currently seeking congressional approval to expand current coinmaking capacity by building a new Denver Mint at a cost of \$65 million. The new mint is being justified on the basis that increasing demand for coins, estimated to reach 18 billion coins by 1980, will leave practically no margin for error in coin requirement forecasting and no reserve capacity to meet coin requirements beyond 1980. (See pp. 5 to 6.)

GAO found that the Bureau had four different models available for forecasting future coin requirements. Depending on the assumptions used in these models, 1990 coin requirements range from about 17 to 50 billion coins. These different projections were not made available to the Committee. (See pp. 6 to 9.)

A current Bureau study projects 1990 coin requirements to range from between 26 to 64 billion coins. The study projects the most likely estimate to be about 41.5 billion coins; of that total about 91 percent or 37.6 billion coins are cents. (See pp. 9 to 10.)

GAO believes that a previously developed Bureau coin-forecasting model, using updated information, offers a reasonable alternative to the current Bureau study's 1990 coin requirement projections. This alternative projection amounts to about 28.8 billion

coins. However, either projection is significantly higher than the Bureau's current coinmaking capacity. (See pp. 10 to 13.)

The Bureau study also suggests that in 1990 it may cost 10.25 cents to add one cent into circulation because of projected increases in demand for copper cents, cent-manufacturing and distribution costs, copper prices, and cent attrition rates. If these projections are reasonable, serious consideration should be given to making changes to the existing coinage system.

Changes presently being considered by the Bureau involving the cent are adding a 2-cent coin, changing from the copper cent to an aluminum cent, and even eliminating the cent coin. Any of these changes could dramatically affect the production needs and the suitability of the proposed new Denver Mint. (See pp. 13 to 17.)

The Bureau has several options available to better utilize the space and equipment presently contained in its facilities and consequently increase coinmaking capacity. Increases to achieve total production of over 50 billion coins a year can be made by such actions as (1) opening the San Francisco Assay Office to production of general circulation coinage, (2) combining functions and renovating space to make available more space for coinmaking equipment, and (3) relying on commercial suppliers for coinage metal, thus using metal production space for coin production. (See pp. 18 to 27.)

Further, the Bureau could use present capacity, now greater than demand, to stockpile cent coins for future use, thereby delaying or perhaps eliminating the need for major expansion of production capacities. (See pp. 27 to 28.)

GAO believes these facility changes are better alternatives to increasing production than is the proposed expenditure for a new mint structure. This is especially true since rising costs may bring about a change to the coinage system.

The present Denver Mint has been stated by mint officials and others to be outmoded and obsolete. However, GAO finds that while the facility appears to be overcrowded and perhaps hazardous to workers in its present state, it does not need to be replaced. The production area should be revised to improve the workflow and working conditions. This change could result in loss of some production capacity. (See pp. 29 to 32.)

GAO believes the Bureau's estimate of construction costs for a new Denver Mint may be too high because (1) space requirements appear overstated, (2) construction costs were based on Philadelphia Mint construction that included several high-cost features not needed for the Denver Mint, and (3) escalation for inflation appears duplicated. (See pp. 32 to 35.)

RECOMMENDATIONS

GAO recommends that the Secretary of the Treasury:

- Evaluate the various options presented in this report and, in conjunction with a continuing reevaluation of demand estimates, prepare a plan so that currently available facilities can keep pace with coin demand using the smallest possible investment in renovation, new equipment, and other costs. (See p. 38.)
- Develop contingency plans on actions to take if copper prices, manufacturing and distribution costs, and cent attrition rates rise significantly, including whether to issue a 2-cent coin, change the metal of the cent coin, or discontinue the cent coin. (See p. 38.)
- Examine the production system in the current Denver Mint and revise the capacity and workflow to get the best available production consistent with safe, healthy working conditions. (See p. 38.)

AGENCY COMMENTS AND UNRESOLVED ISSUES

The Department of the Treasury stated that a decision needs to be made regarding the future of the existing U.S. coinage system especially as it pertains to the cent.

The Department also stated that if the decision is made to eliminate the cent coin, a new Denver Mint is not required, and no further action will be taken by the Department on the new mint. However, if the decision is to continue cent production to 1985 and beyond, the Department intends to seek increased permanent cost-effective production capacity.

The Department also believes that the options GAO outlined to increase the Bureau of the Mint's coinmaking capacity need more examination and refinement, both as to the increased production they would actually yield, and the practicality and cost of implementation. The Bureau of the Mint has started this examination.

The Department believes that Congress should act favorably on the authorization request for the new mint while it considers the future of the U.S. coinage system and Bureau of the Mint examines the practicality and the cost of all the options available for increasing its current coinmaking capacity. The Department believes this would provide flexibility by allowing it to proceed with the project should that prove to be the most cost-effective solution. The Department states that Congress could still retain control over the project through the appropriation review process.

GAO believes that in light of the uncertainty associated with projecting coin requirements, the possible changes in the coinage system, the moderate increases in production capacity that can be implemented, and the possible increased reliance on contractors, a sizable capital expenditure at this time would be premature.

CHAPTER 1

INTRODUCTION

The Bureau of the Mint has asked the Congress for \$65 million to construct and equip a new U.S. Mint in Denver. The Bureau has asked for this new mint on the basis that coin demand is continuing to increase and will soon outstrip the production capability of its mints. The House of Representatives has approved the authorization. As the authorization request was being considered by the Senate Committee on Banking, Housing, and Urban Affairs, a controversy arose over the estimated construction cost of the new Denver Mint and GAO was asked to review the need for a mint and to report on any other options open to the Bureau for meeting its production needs.

MINT COINAGE ACTIVITIES

A primary mission of the the Bureau of the Mint is to produce United States coins to satisfy expected demand. Other activities relevant to production capability are the manufacture of uncirculated and proof coins for numismatic purposes, coins for foreign governments, and commemorative medals.

During the history of U.S. coinmaking, 19 different coins have been issued for circulation in denominations ranging from 1/2¢ to \$20. Various metals have been used, including gold and silver along with base metals and alloys. Gold coinage was stopped in 1933 and silver was mostly discontinued as a coin metal in 1966, except for some numismatic and 50-cent coins. Some regions of the Nation experienced a copper cent coin shortage in 1973-74 when rising copper prices threatened to make the intrinsic value higher than face value and penny hoarding resulted. At that time, the Department of the Treasury requested standby authority to change the metal content of the cent from copper to a new alloy. Before this authority was granted, copper prices retreated and the "crisis" disappeared.

The present profile of U.S. coinage includes six denominations of coins--1¢, 5¢, 10¢, 25¢, 50¢, and \$1--with all coins being made of base metal alloys of copper, nickel, and zinc, copper being the primary ingredient. Manufacture of these coins at the present time is primarily at mints in Philadelphia and Denver. The San Francisco Assay Office has made some coins in recent years, and the West Point Bullion Depository was pressed into coinmaking service in 1974.

Coin demand for all denominations has steadily increased over the years, although it exhibited some seasonal instability and decreases during periods of economic recessions. ^{1/} The most dramatic increase has been in cent coins. For example, from 1959 to 1975, annual cent production increased by 8.7 billion coins while all other denominations increased by only 2.9 billion coins. Total production increased from 1.6 billion to 13.1 billion during this period. Since 1959, when the current cent design was first made, 73.7 billion cents have been distributed.

The manufacturing processes required to produce the six coin denominations from various metal alloys include:

- Melting and casting: A predetermined mix of metals is melted and cast into ingots.
- Hot and cold rolling: Ingots are reduced to the proper dimensions and the resulting strip is rolled into coils (See fig. 1.)
- Blanking: Round pieces of metal (called blanks or planchets) are punched out of the coils of strip.
- Annealing: The blanks are softened by heating and then cleaned, polished, rinsed, and dried.
- Upsetting: Soft blanks are rolled on their edges through a machine that raises rims around the edges.
- Stamping or coining: The blanks receive the obverse and reverse impressions from coinage dies in heavy presses.

The Philadelphia Mint has all six processes in its present facility, although it produces only part of what it needs for coin strip. The Denver Mint and the San Francisco Assay Office have only the last four processes, and the West Point Bullion Depository has only the final two processes. Coil strip and annealed blanks not manufactured in-house are purchased from commercial suppliers.

^{1/}Economic recessions took place during fiscal years 1956-1958 and 1968-1970. An economic recession also occurred during fiscal years 1973-1975, but the impact on coin demand was only limited because rising copper prices during that period led to increased demand for cents.

FIGURE 1



HOT ROLLING AT THE PHILADELPHIA MINT

SCOPE OF REVIEW

We reviewed current coinage operations and investigated ways coinage could be increased within the facilities presently available to the Bureau of the Mint. We also reviewed the Bureau's cost estimate for the proposed Denver Mint. The review was done at the various coinmaking facilities, at the Bureau's Washington Office, at the facilities of strip and coin blank suppliers, and at the General Services Administration, which assisted in the construction cost estimate.

We reviewed estimates of future coinage demand prepared by a Bureau of the Mint consultant, along with this consultant's recommendations for increasing coinage capacities and suggestions for future changes to the U.S. coinage system.

CHAPTER 2

COIN REQUIREMENT PROJECTIONS

Future requirements for coins, as with any commodity, cannot be known with absolute certainty. Coinage requirements are influenced by economic conditions and demographic and sociological phenomena, which are often difficult to project. In spite of this inherent uncertainty, however, reasonably accurate long range forecasts are necessary to allow the Bureau of the Mint to establish production requirements. The Bureau of the Mint needs credible long range planning to assure that the Nation's needs for coins are adequately met. Mint facilities need to be justified in advance of need to allow sufficient leadtime to procure the facilities once a decision to procure has been made.

The Bureau is currently seeking congressional approval to expand current capacity by justifying a new mint in Denver. The Acting Director for the Bureau of the Mint told the Senate Committee on Banking, Housing, and Urban Affairs that increasing demand for coins, estimated to reach 18 billion coins by 1980, will necessitate a new Denver facility.

In this chapter we will examine the (1) Bureau's method of projecting requirements, (2) complexity and accuracy of such projections, (3) alternate methods available for projecting future demand, and (4) some alternatives available to meet the projected increased demands for copper cents.

JUSTIFICATION FOR A NEW MINT

On February 17, 1976, the Acting Director of the Mint before the Senate Committee on Banking, Housing, and Urban Affairs justified the need for a new mint as follows:

"Passage of this bill is essential to assure production of coins in the quantities our nation will need by 1980 and beyond. The present facilities of the Mint could not do so. The demand for coins required for business transactions throughout the country has increased very rapidly during the past fifteen years. In fiscal year 1960, for example, the Mint produced a total of 2.6 billion pieces. By 1970, production had increased to 7.7 billion pieces, and during fiscal year 1975, the Mint's coin production reached 13.4 billion pieces. By fiscal year 1980, it is estimated that the national coinage demand will rise to 18 billion coins per year."

The Acting Director further stated:

"With these (existing) facilities operating at full capacity, including the timely funding and use of additional equipment planned for utilization in existing facilities, the Treasury Department probably will be able to meet the nation's coinage requirements through the 1970's, but with practically no margin for error in coinage demand forecasting and with no reserve capacity by the year 1980."

We believe there are several alternatives to increasing production without a new mint being built. These alternatives will be discussed in chapter 3 of this report. The remainder of this chapter will focus on coin projections, assumptions, and alternate approaches.

Mint coin projections

The Bureau of the Mint used four coin-forecasting models to project coin requirements to 1990. (See app. I for a description of these models). Three of the four models used some type of correlation with time, the other a correlation with economic variables. The models yielded significantly different results.

Total Coin Demand Forecasts

<u>Studies</u>	<u>Year of study</u>	<u>1972</u>	<u>1975</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>
------(billions)-----						
A. D. Little (consultant)	1963	5.515	6.605	9.083	12.366	16.941
Morrison-OPPE (note a)	1967	7.627	9.051	12.035	-	-
Hunter-Friedman (Mint)	1974	8.22	11.18	17.89	29.88	49.91
Hunter-DeLeo (Mint)	1974	8.42	10.02	15.45	23.93	37.05

a/This study was done jointly by Professor George Morrison (consultant) and the Office of Planning and Program Evaluation, Office of the Secretary of the Treasury.

The Bureau of the Mint has used three different methods for forecasting long range coin requirements.

1. The Bureau used a method developed by Arthur D. Little in 1963 which projected coin requirements by estimating the replacement and growth rate for each coin denomination and applying them to the estimated "stock" of coin in circulation.
2. The Bureau analyzed relationships between economic factors and coin demand to estimate coin stock growth rates for each denomination and thus indirectly total coin requirement (Morrison-OPPE model).
3. The Bureau estimated future annual coin requirements by extrapolation of the long term growth rates for each coin denomination. This method, called time series analysis (Hunter-Friedman model), was the one the Acting Director of the Mint chose in his presentation to the Committee. ^{1/}

Since the Bureau chose this model for its projection, we will briefly examine its relative advantages and disadvantages.

Advantages

- Future time values are always known with certainty as contrasted with economic variables whose future values are uncertain.
- Time has served well as a substitute indicator of coin demand for the individual or combined influences of other indicators of coin demand.

Disadvantages

- Different mathematical formulas describing past coin demand can be found. These different formulas may lead to rapidly diverging forecasts of future coin demand.
- Time is of little explanatory value.
- Time does not serve as well as an indicator of coin demand if the growth rate of coins changes from that experienced in the past. Thus, any factors that alter the accuracy of that growth rate, e.g., changes in economic activity, alter the accuracy of the forecast.

^{1/}The Bureau of the Mint chose to use the Hunter-Friedman model because the A. D. Little and Morrison-OPPE model parameters were outdated, although the forecast approaches were still valid.

Having identified some disadvantages in the above model, we took a close look at the Morrison model which recognizes the economic factors. Following are the relative advantages and disadvantages identified:

Advantages

- Demand for coins is related to economic activity, not time.
- Forecasting models developed using economic indicators will show a decreased demand if the economic indicators decline, whereas the Hunter-Friedman model will show ever-increasing demand. To illustrate, during the fiscal years 1956-58 and 1968-70 economic recessions, demand for cents decreased or leveled off, which is not consistent with the Hunter-Friedman model. (See app. II for fiscal years 1954-76 cent production and demand data.)

Disadvantages

- Correlation between economic factors and coin demand in the past has not been substantially better than correlation with time.
- Economic factors are difficult to forecast, especially into the long range future.

Relative accuracy of above projections

The Morrison economic model was developed in 1969 and it forecasted a demand of 9 billion coins by 1975. Actual demand in 1975 approximated 11.5 billion. Can this difference be explained by unusual and unforeseen circumstances? We believe it can. One major factor--the cent coin shortage of 1973 and 1974 and high copper pricing--triggered hoarding which increased demand for the cent by some 2 billion coins. Considering the above variable, which was not foreseen at the time of projection, one cannot help being surprised at how close this projection turned out to be:

	<u>1975</u>
	(billion)
Projection-initial	9.05
Projection-adjusted for abnormal price-inspired demand	11.06
Actual (6 years later)	11.5

Since this model did not project to the 1990 time frame, we have attempted to do so. The results of the two primary models show the following:

	<u>1975</u>	<u>1980</u>	<u>1990</u>
	----- (billion) -----		
Morrison-OPPE	9.05	12.04	21.33
Hunter-Friedman	11.18	17.89	49.91

Conclusion

From the above it is apparent that quite differing results can be achieved from the various assumptions one can make. We do not profess to have a better crystal ball than the Bureau, nor do we consider this to be the key point of whether one projection is better than another. Rather we believe all factors should be pointed out to the decision-makers to give them adequate options and opportunities to chose from alternatives.

We believe the foregoing discussions certainly demonstrate that more than one method exists for projecting needs with considerable differences in end results. We believe all these factors need to be clearly provided to the decisionmakers before a firm decision is reached. We believe more work is needed before such a decision to build is made. Following is a discussion of current Bureau efforts and alternative considerations.

CURRENT BUREAU OF THE MINT STUDY

After the models discussed above were developed, the Bureau decided to have a contractor, the Research Triangle Institute (RTI), make a comprehensive study 1/ of U.S. coinage requirements.

RTI developed a time series (trend) model similar to the Hunter-Friedman model. The advantages and disadvantages of using this type of model have been previously described. The major differences between the two models are that (1) RTI used fiscal years 1954-75 coin demand 2/ data while

1/The study has not yet been completed at the time of our review. Data used from the study should be considered preliminary. However, the study was recently completed showing only minor differences from the data we used.

2/RTI used net payout of coins by Federal Reserve Banks as an indicator of coin demand since historical data on actual demand for coins was not available.

Hunter-Friedman used 1950-73 data, (2) RTI projected coin demand for each coin denomination while Hunter-Friedman projected only cent and total coin demand, and (3) RTI developed three statistically valid coin demand projections while Hunter-Friedman used just one projection.

RTI estimated total 1990 coinage requirements to range between 26 to 64 billion coins by projecting trends developed from fiscal years 1954-75 coin demand data into the 1976-90 time period. RTI considered the most likely estimate--the one it recommended should be used for facilities planning--to be about 41.5 billion coins; of that total about 91 percent or 37.6 billion coins are cents. Therefore, we concentrated our review efforts on determining the mathematical accuracy and logical consistency of RTI's cent projections.

We found that RTI used acceptable statistical methods to develop its trend models. However, we believe that limitations inherent in RTI's model and inclusion of fiscal year 1974-75 cent demand data in the data base is likely to result in overstated cent requirements for the 1976-90 forecasting period.

As previously discussed a major limitation of the time series (trend) model is that it assumes coin demand will continue to increase at a mathematically prescribed rate. Therefore, any unusual factor, such as great economic activity, inflation, hoarding of coins due to anticipated or actual rise in the prices of copper and zinc, etc., will greatly influence the outcome and can distort the validity of the forecast.

Published statistics on such indicators of economic activity as gross national product, consumer price index, and population indicate that economic activity will grow at a slower rate in the 1976-90 time period than in the 1954-75 time period. For example, according to a nationally recognized economic consulting firm, the consumer price index, which grew at an average rate of 6.7 percent for the 1970-75 time period, is projected to grow at an average annual rate of only about 4.5 to 5.3 percent between 1976 and 1990. Similarly, the (current dollar) gross national product, which grew at an annual rate of about 8.5 percent between 1970 and 1975, is expected to grow annually only at about 7.9 percent over the 1976-90 period. Also, according to the U.S. Bureau of the Census, the U.S. population, which grew at an average annual rate of about 1.5 percent during 1954-75, is not expected to continue to grow as fast.

Furthermore, the increasing use of bank credit cards and checks, the projected use of the electronic funds-transfer concept, the decline in the rate of growth in vending machine sales, while considered by RTI, were not incorporated in its trend model. RTI stated that these factors are not expected to reduce future cent requirements significantly. While it would be presumptuous to forecast the precise impact these factors may have on future cent requirements, there can be little doubt that they would tend to lessen the rate at which the demand for cents has increased in the past. We believe that the net effect of the different growth trends indicates that the rate of growth for the cent will not be as high as predicted in the RTI's most likely forecast for the cent coin.

RTI's data base adjustments did not include adjustments for abnormally high cent demand in fiscal years 1974 and 1975, which were caused by the "cent shortage" evidenced during the latter half of 1973 and all of 1974. 1/ In contrast, RTI excluded demand data for nickels, dimes, quarters, and half dollars for the mid-1960s which was also abnormally high. This high demand was caused by clad coinage (75 percent copper and 25 percent nickel clad on a copper base) replacing the then-existing silver-based coinage. If RTI had excluded fiscal years 1974 and 1975 cent data, RTI's 1990 coin projection would have decreased from 41.5 billion coins to about 37 billion coins--about 4.5 billion coins.

The inconsistent data base adjustments, the projected trends in economic activity, and the apparent reasonableness of the factors included in the Morrison economic model suggest that the Morrison model, using updated information, may be used to forecast 1990 coin requirements. One update which was previously discussed added about 2 billion coins to the Morrison forecast to account for the 1973-74 cent shortage. Another is to use a projected annual growth rate for the (current dollar) gross national product for 1976 through 1990, developed by a nationally recognized consulting firm, as an indicator of future economic activity. The use of these projected gross national product growth rates led to a 1990 coin demand estimate of 28.8 billion coins. 2/ The following table shows the unadjusted and

1/This "cent shortage" resulted from speculative hoarding of cents caused by copper price rise and anticipated further price increases.

2/The estimate reflects a constant annual cent attrition rate of 13 percent for 1976-90. The estimate will change if the attrition rate increases or decreases.

updated Morrison economic model and RTI's most likely estimates of total coin requirements for 1980-90.

Annual Total Coin Requirement

<u>Year</u>	<u>Unadjusted Morrison estimate</u>	<u>Updated Morrison estimate</u>	<u>RTI estimate</u>
------(billion.)-----			
1980	12.0	17.4	18.4
1981	12.7	18.6	19.9
1982	13.5	19.6	22.0
1983	14.3	20.7	23.7
1984	15.1	22.2	25.3
1985	16.0	23.3	28.2
1986	17.0	24.4	29.5
1987	18.0	25.3	33.1
1988	19.0	26.3	35.7
1989	20.1	27.7	38.8
1990	21.3	28.8	41.5

We tested the reasonableness of the updated Morrison model forecast by using a model we developed ourselves. Our model used gross national product and consumer price index projections developed by a nationally recognized economic consulting firm and U.S. Bureau of the Census projections of population growth. It excluded fiscal year 1974-75 cent data. Our forecast of total 1990 coin requirements ranged from 25.6 billion to about 28.0 billion coins. RTI projections, which either partially or fully use economic indicators, showed a range of 25.3 billion to 38.7 billion coins for total 1990 coin requirements. However, these RTI forecasts do not exclude fiscal years 1974 and 1975 cent data which, we believe, should have been excluded.

On the basis of these tests, we believe that the use of the updated Morrison model would provide a reasonable alternative projection to RTI's most likely estimate of 1990 coin requirements.

Conclusion

Regardless of which 1990 projection we use, either projection is significantly higher than the Bureau's current production capacity. While there are a number of options available to expand production capacity, including some which are relatively inexpensive and could be easily implemented (see ch. 3 for a discussion of these alternatives), the Bureau is also considering possible changes to the current U.S. coinage system, which could dramatically change

coin requirement projections and thus the requirement for additional mint facilities. Since cents presently represent about 75 percent of the total annual coin production and this percentage is expected to increase, we examined changes under consideration for the cent. We believe some of these potential changes need to be considered before proceeding, since it is not reasonable to assume that the Bureau would continue indefinitely to produce cents at an ever-increasing rate with higher and higher production and distribution costs.

COINAGE SYSTEM CHANGES APPEAR NECESSARY FOR THE CENT

Assuming no changes in denominations, configurations, or material compositions of the present U.S. coinage system, the Bureau of the Mint is rapidly approaching a situation where projected increases in demand for copper cents ^{1/} coupled with projected manufacturing cost increases suggest a change to the current coinage system.

Compounding the problem is that the current price of copper, \$0.75 per pound, is projected to rise to about \$1.50 per pound by 1990. The Bureau of the Mint determined that the point where the material value contained in the cent equals the face value of the coin occurs at about \$1.50 per pound. When copper prices approach that level, hoarding of cents for their material value is expected to occur as it did in 1973-74 when copper prices rose to about \$1.40 per pound. If copper prices increase again, the rate of withdrawals from circulation will accelerate and the percentage of coins paid out by the Federal Reserve Banks, which simply constitutes replacement for attrition, will increase. By 1990, RTI projects that less than 20 percent of the coins paid out will be added to the circulating pool of coins.

RTI identified three major alternatives for changing the existing coinage system which have been presented to the Bureau for consideration:

- Change from a copper to an aluminum cent.
- Introduce a 2-cent coin to cocirculate with the cent.
- Discontinue manufacturing cent coins.

These alternatives are based on the same data used by RTI to compute its estimate of coin requirements as previously discussed beginning on page 9.

^{1/}The copper cent is actually a 95-percent copper, 5-percent zinc coin.

Change from copper to an aluminum cent

After investigating a wide range of metals, alloys, and nonmetallic materials, RTI concluded that the best material for a new cent, if required, is aluminum. RTI believes that implementation of this option by 1978 will result in considerable positive seigniorage, 1/ \$284 million annually by 1990.

On the other hand, annual cent requirements are expected to increase over 20 percent--from 37.6 to 45.1 billion cents--by 1990, due to the accelerated withdrawal of copper cents from circulation and to the slightly higher attrition rate anticipated for an aluminum cent. (RTI's projections of annual coin requirements for all three alternatives to the existing coinage system are shown in app. III.)

Introduction of 2-cent coin

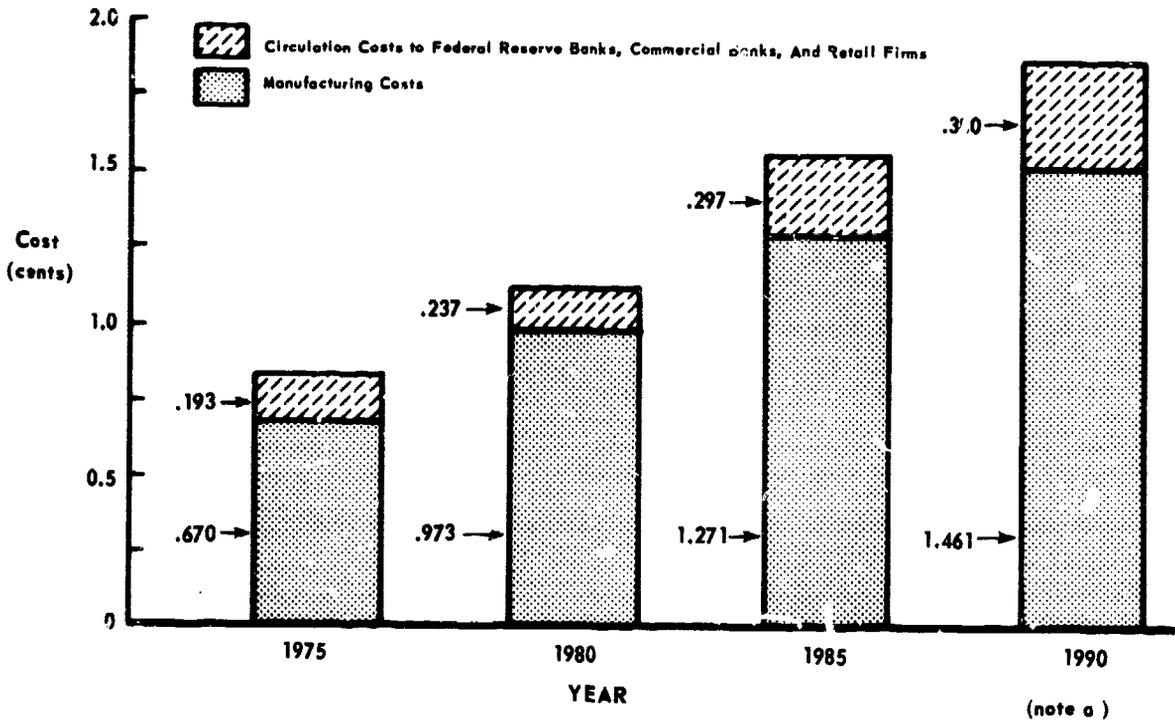
RTI believes that introduction of a 2-cent coin to cocirculate with the penny would provide the Bureau of the Mint an opportunity to limit copper cent production by offering a substitute denomination. RTI thinks that cent production could be limited to 4 billion coins, which they believe is sufficient to discourage excessive cents hoarding by coin collectors. Additional benefits to be gained by implementing this alternative would be (1) a 30-percent reduction of 1990 coin requirements, (2) postponement of current mint production facility expansion plans by about 3 years, and (3) less expansion when ultimately required. Disadvantages would include possible lack of public acceptance of the 2-cent coin and a requirement to modify or replace coin-sorting and other coin-processing equipment currently used by retail firms and banks.

Discontinuance of the cent coin

If the Bureau of the Mint were to continue the production of copper cents, the total costs for each cent manufactured and distributed would increase from 0.86 cents in fiscal year 1975 to a projected 1.84 cents in 1990. The current and projected costs to manufacture and distribute a cent are shown in the following illustration.

1/Seigniorage, as used by RTI, is the difference between the face value and production and distribution costs of the coin.

**COST TO THE BUREAU OF THE MINT
TO MANUFACTURE AND
DISTRIBUTE A CENT COIN**



a/As previously mentioned, RTI projects that only 20 percent of the 37.6 billion cents, or 7.52 billion cents, estimated to be paid out in 1990 by the Federal Reserve Banks will be additions to the circulating pool of cents. RTI projects that it will cost about 10.25 cents to add each of the 7.52 billion cents into circulation. This cost was calculated by including not only the manufacturing and distribution costs incurred by the Bureau of the Mint, but also the processing, handling, and inventory costs incurred by Federal Reserve Banks, commercial banks, and retail firms.

If, on the other hand, the Bureau were to discontinue producing the cent coin in 1978, most of the approximately \$0.5 billion cost to add cents to the circulating pool of cents from 1978 to 1990 would be avoided. Additional benefits would include:

- No additions to existing mint production facilities would be necessary.

- An immediate reduction in purchases of about 100 million pounds of coin strip by the Bureau of the Mint.
- Savings generated by reductions of an estimated 534 mint personnel.
- Reduced shipping costs amounting to about \$2 million annually.
- Reduced costs of shipping, storage, and handling to Federal Reserve and commercial banks and retail merchandising firms.

Disadvantages would include:

- A moderate increase in the production of other coin denominations.
- New pricing methods which could have an inflationary impact.
- Retraining on rounding for personnel for handling cash transactions.
- Loss of revenues to cent strip manufacturers and the trucking industry.
- Adverse community impact associated with mint personnel reductions.

RTI believes that implementation needs to be time-phased with some forewarning to the public. They believe that an announcement of the scheduled termination of cent production should be made at least 1 year in advance. This time period would allow for an orderly and efficient transition by businesses in pricing, packaging, and sales policies and for a public relations campaign to educate the public on the implications of eliminating the cent.

Conclusion

Assuming that RTI's cent requirement, copper price, cent-manufacturing and distribution cost, and cent attrition rate projections are reasonable, it will cost about 10.25 cents in 1990 to add 1 cent to the circulating pool of copper cents. It does not seem reasonable to pay that amount of money to continue to produce a coin which has little purchasing power.

We believe that serious consideration should be given first to making changes to the existing coinage system,

including those discussed in the report, before proceeding to construct a new mint facility such as the proposed new Denver Mint.

CHAPTER 3

COIN PRODUCTION CAN BE INCREASED

TO MEET NEEDS THROUGH 1990

USING PRESENT MINT BUILDINGS

The Bureau of the Mint has a number of options open to it which if implemented would increase the coinage capacities of its existing facilities from 18.1 billion to over 50 billion coins a year. One option is almost immediately available and requires only a decision to use existing equipment. Other options would require relocating some functions and adding coinage equipment. Still other options would require the Bureau to place increased or total reliance on commercial suppliers for its coinage metal requirements.

Another option is to use present capacity, which will exceed demand for at least the next 4 years, to build up cent inventories to meet future requirements.

CURRENT CAPACITY OF OPERATING FACILITIES

The current operating coining facilities are the Philadelphia and Denver Mints and the West Point Bullion Depository. These three facilities can produce about 18.1 billion coins a year, based on the maximum output of the currently available production equipment.

<u>Locations</u>	<u>Equipment capacities</u> (billions)
Philadelphia Mint	8.4
Denver Mint	8.0
West Point Bullion Depository	<u>1.7</u>
Total capacity	<u>18.1</u>

None of these facilities have operated up to these capacity figures; however, the Denver and Philadelphia Mints have the equipment that will provide the above capacities. The Denver Mint does appear overcrowded and its capacity should probably be reduced. This is discussed further in chapter 4.

OPTIONS AVAILABLE TO INCREASE PRODUCTION IN EXISTING FACILITIES

The following table lists changes in mint operations which could be made to increase future production within

present facilities of the Bureau of the Mint. In each case we estimated the additional cent coin production that could result from the change.

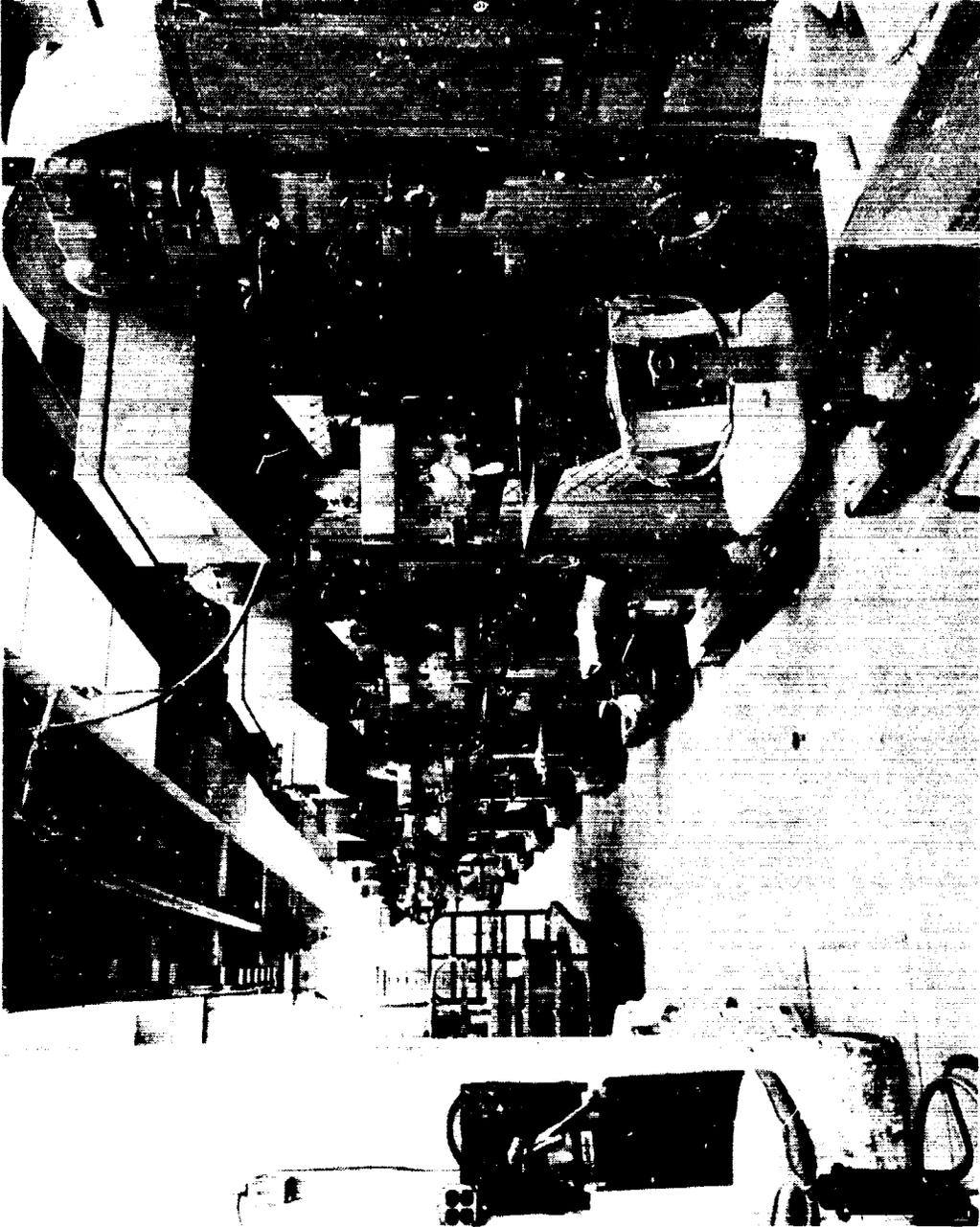
<u>Change</u>	<u>Estimated capacity increase</u> (billions)
Use San Francisco Assay Office	2.0
Move medal production from Philadelphia and increase coinage space	3.3
Renovate Philadelphia production area	1.6
Replace West Point coin presses	0.6
Increase coin presses at West Point	1.1
Purchase all clad strip for the Philadelphia Mint	3.3
Purchase all other strip for the Philadelphia Mint	15.1
Purchase 1¢ blanks for the Denver Mint	<u>5.6</u>
Total increase	<u>32.6</u>

Use production capacity at
San Francisco Assay Office

The San Francisco Assay Office was built in 1937. Some general circulation coins have been made in the past several years and some foreign coins have been made at this location. Since 1964 the major workload has been manufacturing proof coins and packaging proof and uncirculated coins.

The Assay Office now has coining presses and other equipment for making general circulation coins. (See fig. 2.) The proof coin presses are in a separate area. The equipment for making general circulation coins can make about 2 billion coins a year and the officer-in-charge told us that production could commence in 6 months after a decision was made to use the facility. Contracts for purchase of strip could be obtained within 6 months based on current procurement experience.

FIGURE 2



COIN PRESSES AVAILABLE FOR PRODUCTION AT THE SAN FRANCISCO ASSAY OFFICE

Move medal production operation from Philadelphia and increase coinage space

The Philadelphia Mint makes various commemorative medals, using about 20,000 square feet for manufacturing and packaging these medals. Relatively few medals are made in any one year, except that in 1973 through 1976 a number of special bicentennial medals were made. Mint officials expect post-1976 production to return to pre-1973 levels.

San Francisco Assay Office officials told us they could make the commemorative medals along with proof coins on their present equipment, except that equipment for larger pieces (over 1-1/2 inch diameter) would require transferring some equipment from Philadelphia. Philadelphia Mint officials, in turn, told us that transferring this function to San Francisco would be feasible if some equipment were kept for making sample coins and small production runs.

If this transfer were made, the 20,000-square-foot area would become available for other use. The Philadelphia Mint deputy superintendent said the mint would want to use part of the vacated area for research and development but would make the balance of the space available to install coining presses. A 1973 engineering study report shows that the space can be used to accommodate 24 coining presses, but that structural limitations in this area require that the location of production equipment be carefully controlled. The deputy superintendent told us that blanking, annealing, and other operations necessary to supply blanks to these presses could be handled by equipment already available in the existing coin production area. These 24 presses would add production capacity of 3.3 billion cent coins a year.

Philadelphia officials estimated that purchasing new presses, some automated handling equipment, and installation would cost about \$2.5 million. Costs to transfer the medal equipment are estimated to be about \$9,300. Leadtime for obtaining and installing the new equipment at Philadelphia would be no more than 18 months, based on past experience.

Renovate Philadelphia Mint coin production area

The current coinmaking capacity at Philadelphia is 8.4 billion coins. However, the Bureau has been planning for some future expansion in coinmaking at this mint by hiring an industrial engineering consultant to recommend ways to increase capacity to 10 billion coins a year. The consultant has made a preliminary recommendation which includes changes to material handling, some moving of equipment, and some renovation of the present work area--mainly

adding a mezzanine floor area. Also, some new equipment would have to be installed.

The recommendation is for a time-phased approach which would make the changes gradually between now and 1980. The consultant has prepared a preliminary \$1.1 million cost estimate of this renovation but the Bureau has not yet approved it.

The renovation has been discussed with Philadelphia Mint officials who agreed the changes can be accomplished. This renovation would result in an increase of 1.6 billion coins a year to the Bureau's coinmaking capacity.

Change West Point equipment to more productive models

The West Point Bullion Depository currently has 20 coining presses which are limited to striking two 1-cent coins at each stroke (a dual press). Most of the Bureau's coining presses can strike four 1-cent coins at each stroke (a quad press). These quad presses are somewhat larger than the dual presses. Operating experience on the quad presses in Denver and Philadelphia, as given to us by mint officials, is that quad presses run slower and experience a higher downtime than the dual presses used at West Point.

West Point officials say that quad presses can replace the dual presses, but that only 16 quad presses can be placed into the press room. The other equipment (upset mills, riddlers, and counting equipment) needed to handle the production from 16 quad presses is available or could be accommodated.

These 16 presses can increase the current capacity from 1.7 billion to 2.3 billion cent coins a year, or a 0.6-billion-coin increase.

Leadtime to make this change would be the 18 months needed to purchase and install the 16 new presses. The cost of 16 new quad presses and other equipment would be about \$1.2 million.

Increase coin presses at West Point

The West Point Bullion Depository has a number of vault rooms, some of which have been renovated to accommodate coining equipment and for other uses. Some of the vaults are now empty or used for coin storage. We asked the officer-in-charge if one or more vaults could be used

to hold additional coining equipment and thereby increase the capacity of the facility.

We were told that the facility could be renovated to add eight coin presses and other required coining and support equipment, assuming no vaults would be required for coin storage. This would be the maximum capacity increase they could handle. The addition of eight coin presses would increase capacity by 1.1 billion cent coins a year.

The officer-in-charge estimated renovation costs, on the basis of past experience, to be \$125,000. The cost of the additional coin presses and other equipment required would be about \$600,000. We believe that renovation could be accomplished within the 18 months leadtime required for the new equipment.

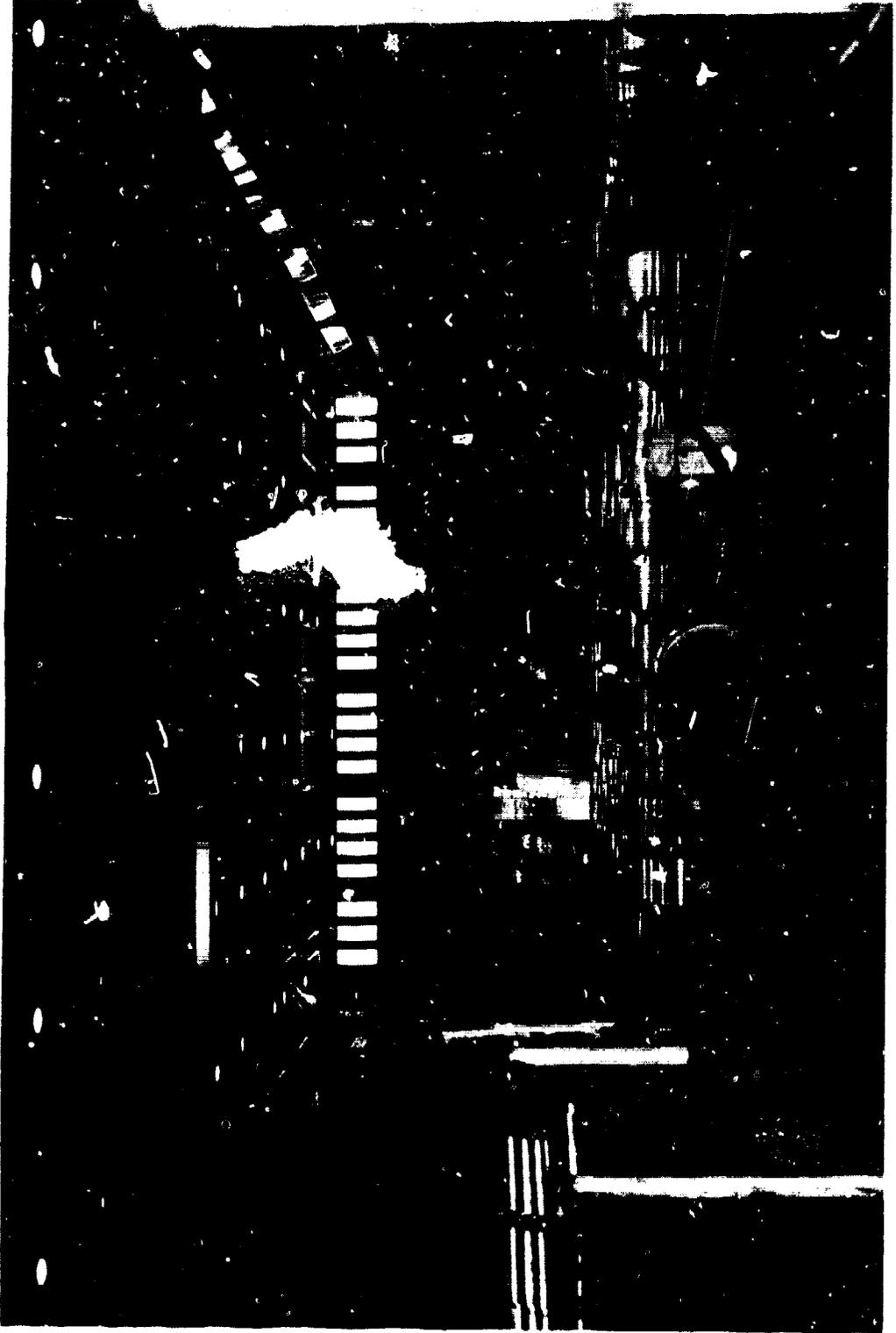
Discontinue stripmaking operations
and add coining equipment at the
Philadelphia Mint

The Philadelphia Mint has its primary production area on one floor, containing a total of 142,000 square feet. About 92,100 square feet is used to produce copper, bronze, and cupro-nickel strip, from which coin blanks are punched. Most major equipment for this strip production area was purchased in 1969 and total equipment cost was about \$13 million. As of May 1976 the book value was about \$8.9 million. The major equipment is being depreciated mostly over 15- and 20-year periods.

The largest part of the strip production area, 73,800 square feet, is used to melt, cast, and roll the strip. (See fig. 3.) The remaining 18,300 square feet is used to bond cupro-nickel and copper together to make the clad material for 10¢, 25¢, 50¢, and \$1 coins. The bonding equipment--costing about \$3.2 million--is used only for that operation and, if removed, other strip manufacture for the cent and nickel coins could continue.

Even with this equipment, Philadelphia has been able to make only 35 percent of its strip requirements since 1970, and usually the manufactured strip has been more costly than purchased strip. Up until 1976 the mint's costs were becoming more competitive with purchased strip prices. Had the Philadelphia Mint purchased all its strip requirements in 1975, a cost savings of \$165,113 would have been realized, and in 1976 the mint would have saved over \$1 million had it purchased all strip required.

FIGURE 3



STRIP PRODUCTION AREA

Based on recent purchasing history, there are four suppliers for the bronze strip, two suppliers of cupro-nickel, but only one supplier of clad strip. We discussed the availability of clad strip with representatives of the current supplier company. Supplier personnel told us their equipment can supply almost twice the foreseeable (1990) mint needs for clad material, and they are willing to expand the operation if necessary. They also stated an interest in buying some mint production equipment, especially the bonding mill, if the mint discontinued this operation.

We also visited two other companies, one of which had previously bid on and supplied clad strip to the mint. Both told us they could commit sufficient capacity to meet the mint's needs if they were given some reasonable long term commitment. One company would have to purchase the copper and cupro-nickle strip, however, since they have only the bonding mill operation.

With the number of companies capable of manufacturing clad strip, and the sufficient capacity available from the current supplier, we believe the mint can feasibly rely on commercial suppliers for clad strip. If the Bureau decided to purchase all clad strip, the space currently used for in-house production could be made available for coin production. The space is large enough to hold two automated cent production lines which could produce 3.3 billion coins a year.

The cost of this change would be the cost of the equipment--about \$1.7 million a line for the major items--and its installation and the cost to remove the bonding equipment. Leadtime for new equipment would be about 18 months, based on past procurement history.

As to the remaining part of the strip manufacturing operation, we visited two of these suppliers and they told us the industry could supply all of the Bureau's requirements for the cent and nickel material. If the Philadelphia Mint were to purchase these strip requirements, it could vacate the remaining 73,800 square feet and use this space for coining equipment. The space could be used for automated cent production lines like two such lines now in place at the Philadelphia Mint. The space would hold at least 9 such lines, each capable of producing 1.68 billion coins a year, or about 15.1 billion cent coins.

This option would cost about \$1.7 million for each production line, plus the cost of removing present strip production equipment. There would also be a loss on the

unamortized value of the equipment removed, the amount depending on when the move was made. Leadtime for this option would likely be the time needed to purchase and install the coining equipment, about 18 months, based on past experience.

A problem with this option is the limited shipping and receiving capability of the present mint building. This would have to be studied for possible solutions and costs. Possible solutions could include going to a two- or three-shift shipping and receiving operation, modifying the existing dock area, or adding a new dock area.

Purchase cent blanks to devote
more space to coin presses

The Bureau of the Mint has been purchasing cent blanks from commercial sources to supply some of the needs of the West Point Bullion Depository coining facility. The blanks are annealed by the supplier so that West Point needs only to upset 1/ the blanks, imprint the design with coining presses, and screen the coins to weed out the off-size coins. A major advantage of this procedure is that, where space is limited, more coins can be produced because there is no need for blanking presses and annealing and cleaning equipment. Another advantage is that there is no scrap from the blanking process. About 25 to 30 percent of bronze strip is scrap after the blanks are punched out.

A major disadvantage is that the cost of purchased blanks has been higher than the cost to make blanks in-house. For example, Denver's cost of making annealed cent blanks from purchased strip during the first 6 months of fiscal year 1976 was \$1.55 per 1,000, while procurement of blanks delivered to West Point was \$1.78 per 1,000; a difference of \$0.23 per 1,000 coins produced. A recent study by the Bureau's internal audit staff estimates an even higher cost penalty. We don't know if this cost disadvantage would exist or be as large if blanks were purchased on a larger scale. Purchasing blanks at \$1.78 per 1,000 would result in \$230,000 increased cost for each 1 billion cent coins produced.

As an example of what would happen to costs and production if blanks were purchased, we estimated what could be done at the Denver Mint if it purchased all cent blanks.

1/Upsetting is the manufacturing process where soft blanks are rolled on their edges through a machine that raises rims around the edges.

This move would eliminate the need for six of eight blanking presses and three of five annealing and cleaning lines. The space made available by removing this equipment could accommodate 40 quad-type coin presses capable of making 5.6 billion cent coins annually. The extra cost of the blanks for these coins at \$0.23 per 1,000 would be about \$1,288,000. Also, Denver would have to buy cent blanks for its existing coin presses, and the extra cost of these blanks would total about \$1,587,000.

The cost for such a change would be the cost for 40 new presses, about \$2.8 million; leadtime for purchasing the presses would be about 18 months.

We discuss available industry capacity to supply blanks with the Bureau's two sources of supply. They said their total available capacity is now only about 70 percent of what would be needed for Denver. Both said that increased supply could be made available.

We also considered the possibility of purchasing cent blanks for the Philadelphia Mint. However, as previously discussed, limited shipping and receiving capability of the present mint building would make this an unattractive and possibly a very costly option.

BUILD INVENTORY TO SUPPLY FUTURE DEMANDS

The coinmaking capacity of the three facilities now in use is about 18.1 billion. The Bureau of the Mint also has available the production capability of the San Francisco Assay Office, which could add 2 billion coins to this capacity, if the Bureau decides to use it. If we assume that either Research Triangle Institute's or the modified Morrison model coin demand figures are accurate, this capacity is not needed until about 1980. These facts present the possibility of stockpiling excess manufactured coins to meet future demand.

If, for example, the Bureau should put the San Francisco operation into production and replace the medal production in Philadelphia with additional coining capacity beginning in fiscal year 1978, the inventory accumulation could be used to meet the Bureau's estimated demand (41.5 billion coins a year by 1990) through 1986. If we were to assume that the modified Morrison model estimate of demand (28.8 billion a year in 1990) is more accurate, the mint could supply future demand until 1984 using only the 18.1 billion coin capacity of the three facilities now in use.

The catch in this alternative is the costs involved in storing these coins. Available storage in the Bureau's

present facilities is limited to approximately 4 to 6 billion coins, and storage of the quantities needed for this alternative would require obtaining additional space, double movement of coins, and additional security measures for the storage sites.

The Facilities Project Manager has looked into possible storage at a Government-owned facility (Rocky Mountain Arsenal) near the Denver Mint. One available building has capacity to store about 4 billion cent coins. There would be no rental on this building, but some renovation would be necessary.

Possibly there is similar Government-owned space in the Philadelphia area that could be available for coin storage. The Philadelphia Mint has looked into obtaining off-site storage for coins and has found some space for a small amount of storage at Frankford Arsenal and other space that will become available in the near future. They also obtained some information on the cost to install an alarm system.

Only the Denver and Philadelphia Mints would require external storage. Both San Francisco and West Point could ship out all their production to nearby Federal Reserve banks and branches.

CHAPTER 4

CURRENT DENVER MINT PROBLEMS AND ESTIMATED COSTS FOR A NEW MINT

The primary reason advanced by Bureau of the Mint officials for a new Denver Mint is the expected increased demand for coins and resulting need for an increased production capacity. They state that expanded production cannot be obtained in the present structure, and that the current building is too crowded and obsolete. While we believe there are alternatives available to increase production without a new mint being built, we did look into the problems of the present building to see whether they are serious enough to require a replacement. We also evaluated the cost estimate presented to the Congress for the proposed new mint.

PROBLEMS REPORTED AS PRESENT IN DENVER MINT BUILDING

In statements on the proposed legislation now before the Congress to authorize funding for a new mint, Bureau of the Mint personnel commented on problems with the present Denver Mint. Such comments included "the present Denver Mint is 70 years old and structural limitations relating to floor loads and work flow severely restrict the development of efficient production operations," and "the outmoded production facilities of the Denver Mint." The Denver Mint Superintendent also told us of problems with excessive noise levels in the production area.

Research Triangle Institute, under its objective of assessing coinage production capabilities and recommending changes, stated:

"This study adopted the assumption that if a new Mint were required, it would be constructed in Denver; because Denver is a rational location for a Mint to economically service the western part of the U.S.; prior to the study a site in Denver had already been purchased and preparations for a new Mint were well in progress; and the existing Denver Mint is effectively obsolete due to its inefficient layout, limited access, excessive noise levels, extreme congestion, and potential structural fatigue."

RTI then concluded,

"Under any circumstances the existing Denver Mint must be replaced or its long-term capacity must be curtailed substantially."

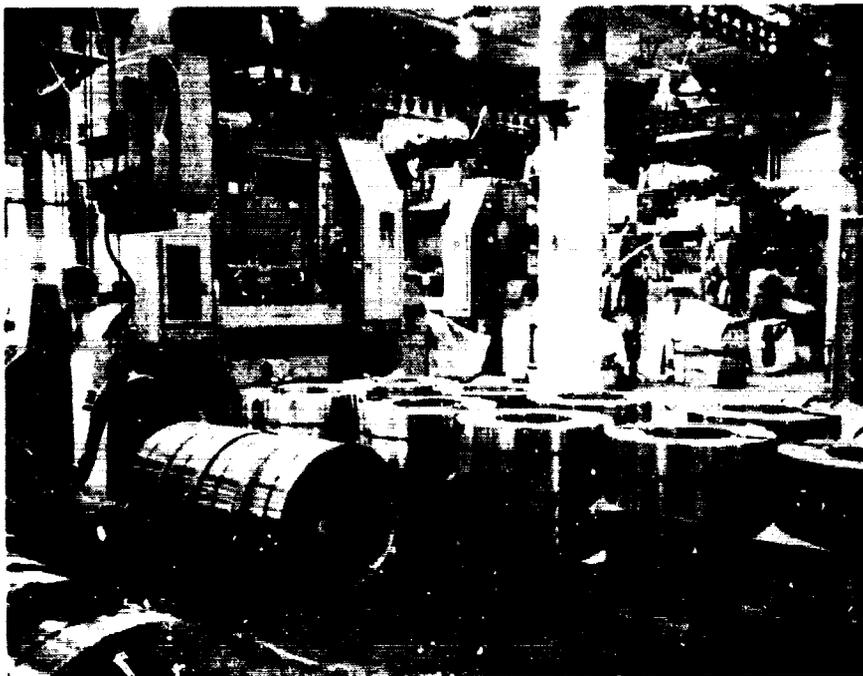
FINDINGS RELATED TO REPORTED PROBLEMS

There are problems with the current Denver Mint building, but the serious one of structural fatigue has not been found in three recent engineering studies.

We observed that the other problems mentioned are present, but we believe they can be reduced or eliminated if plant capacity is reduced. The equipment buildup in the Denver Mint has apparently overtaxed the usable floor space. While this situation might be workable for the short term, we believe it should not continue over the long term.

The two most serious problems we observed are congestion and high noise levels. Production machines are spaced quite closely and, more importantly, in-process material is stored in aisles and in various out-of-the-way locations. (See fig. 4.)

FIGURE 4



CONGESTION AT THE DENVER MINT

A measure of the extent of congestion is a comparison of space used for production equipment and in-process storage for an 8.0 billion coin facility in Denver with the estimated space needed in Philadelphia for a similar facility designed to produce 10 billion coins. Denver has about 38,000 square feet which is being used for its production while the Philadelphia area is designed with over 52,000 square feet. However, about 5,000 square feet of the space being used in Denver probably should not be so used, in our opinion, because of its location and for safety reasons. A simple comparison of square footage, 33,000 vs. 52,000 thus indicates that the Denver production should be less than the 8.0 billion coins it is now equipped to produce.

The proximity of various pieces of equipment to one another--each of which is fairly noisy--creates higher than acceptable noise levels throughout most of the production area. Workers in the area are issued ear plugs or muffs to lessen the noise, but some workers have successfully claimed that they have suffered permanent hearing damage. A plan to enclose the noise-offending equipment has been proposed for the Philadelphia Mint work area. Similar enclosures might also be placed around equipment in the Denver Mint production area to reduce this noise problem.

The production layout in the Denver Mint is obviously not as good as could be obtained with a one-level building or with some automated material-handling equipment. In-process material must be shunted up or down for storage in large tanks and on elevators. Also, some equipment is not located in line with the necessary process flow, thus requiring material to be hauled longer distances than necessary and adding to congestion. Whether this is significantly inefficient is difficult to prove. Inefficiency can usually be measured, we believe, by relative costs per unit of production. On this basis, Denver is not inefficient when compared to the other U.S. mint facilities since Denver's unit costs are less than either Philadelphia or West Point.

Limited access to loading docks was also mentioned as a problem. We analyzed the existing situation at Denver and found that the problem, if any, exists in the scheduling of delivery vehicles. There is sufficient space to handle incoming and outgoing material at a much higher production rate, and space is available on the mint grounds so that vehicles do not have to block city streets in order to gain access to the shipping and receiving docks.

The 70-year age attributed to the building is not completely accurate. Part of the structure was built in 1906,

but the area currently used for production was built in 1945 and 1965.

Overall, we think there are problems in the present Denver Mint, but they are not so great as to require that the structure be replaced. The most serious problems, congestion and high noise levels, can be alleviated, if not completely overcome, by removing some production equipment.

COST ESTIMATE IS OUTDATED
AND POSSIBLY OVERSTATED

The Department of the Treasury prepared a cost estimate in 1975 for legislation to authorize construction of a new mint in Denver. The estimate totals about \$65 million and is composed of the following:

Denver Mint Cost Estimate

(000 omitted)

Building construction	\$27,045
Site development	2,000
Construction cost adjustment to 10/77	8,365
Equipment (includes installation and escalation to 10/77)	14,000
Contingencies	2,971
Exterior lighting, fencing, landscaping, and miscellaneous	1,200
Land acquisition	1,500
Construction management and inspection	2,907
Design, design review, and management	3,975
Start-up, relocation, and transition	<u>900</u>
Total	<u>\$64,863</u>

The estimate is based on a 450,000-square-foot facility equipped for an initial production level of 10.5 billion coins annually. The building will be large enough to allow expansion to about 16 billion coins annually through the installation of additional equipment.

How the estimate was made

In 1971-72 the Bureau prepared a preliminary space survey to determine space requirements for a new facility. General Services Administration (GSA) and Department of the Treasury jointly estimated the cost of the facility at about \$55 million in legislation proposed in 1973. This legislation failed to pass in the House of Representatives.

The latest authorization bill was introduced in March 1975 and contains the current cost estimate of about \$65 million. The cost estimate was increased from the earlier estimate to reflect inflation and increased space requirements. The update also deleted equipment and some, but not all, space for strip production. A strip production capability is not included within this cost estimate and would require another authorization. As mentioned on page 2, the present Denver Mint does not have strip production facilities.

The estimate was prepared jointly by the Bureau's Facilities Project Manager and a GSA cost estimator. Building cost was developed using the Philadelphia Mint construction costs as a base and was adjusted for inflation and the difference between construction costs in Denver and Philadelphia. An add-on of 15 percent was included to meet Occupational Safety and Health Administration standards, to comply with pollution control laws enacted since construction of the Philadelphia Mint, and to allow for the higher cost of multistructure construction. The basic building cost estimate totaled about \$60 per square foot.

Individual estimates for site development and a start-up allowance were prepared by the Bureau's Facilities Project Manager. The only figure within the project estimate that did not require estimation was the cost of land acquisition since the site was purchased from the City of Denver in 1975 at a cost of \$1.5 million. The remainder of the project estimate includes several add-ons, such as an allowance for inflation from the preparation date of the estimate until the midpoint of the construction period, exterior fencing and landscaping, provisions for contingencies, design monitoring, and construction management.

Questionable basis used in the estimate

GSA has guidelines for preparing construction estimates stating that estimating construction cost is not an exact science. This implies that many aspects of estimating are judgment considerations requiring interpretation by the estimator.

A GSA cost estimator stated that several estimating methods have been used in the past, for example, allowance tables for various functional uses of space, and historical costs of similar projects as the basis for construction cost estimates. The GSA cost estimator used the Philadelphia Mint construction costs as the basis for the Denver Mint cost estimate. He believed this was an appropriate procedure because he considered the two projects similar.

We believe this approach may be conceptually reasonable but there are indications Philadelphia Mint construction costs may have been higher than usual which make the two projects not comparable. An internal GSA memorandum discusses possible high costs in the Philadelphia Mint because:

- The building is completely covered in granite with an imposing entrance and lobby.
- The building could be built at considerably less expense if the site would allow a single level.
- Earthwork and shoring are quite extensive and very expensive because of proximity of streets and special internal design.
- Phased construction with accelerated scheduling may have added up to 30 percent to the final cost of construction.
- Exterior treatment requested by the Philadelphia Fine Arts Commission may have increased costs up to \$1 million or more.

Some or all of the above high-cost conditions may not be applicable to the Denver Mint construction. Another indication the two projects may not be comparable for cost-estimating purposes is that the Philadelphia Mint includes an in-house strip production capability which is not planned for the Denver Mint.

We did not attempt to quantify the difference in costs that might be due to the lack of comparability. We did discuss the internal memorandum items with the GSA cost estimator. He said he had not seen this memorandum, and even if he had he would not have changed his estimating method. However, he did say that the Denver Mint probably could be built as much as \$5 per square foot cheaper than his estimate.

Also, we believe that the estimate overstated the probable cost increases because of inflation. The Denver Mint base cost was derived from the Philadelphia Mint actual costs. ¹ These actual costs were then increased by an annual percentage beginning from the contract award date for

¹/The Philadelphia Mint was constructed in four different phases. The sum of the costs for each phase make up the Philadelphia Mint's total actual costs.

each construction phase. It would have been appropriate, in our view, to begin the adjustment for inflation at the estimated completion date for each of the four construction phases. We believe the Philadelphia Mint contractors would have included inflation over the duration of the contract in their bid so that actual contract costs would have included inflation over the construction period. To include an additional factor for inflation would tend to overstate the estimate.

We discussed the space allowances used by the Bureau's Facilities Project Manager with him in detail because we believed certain areas were overestimated. He agreed with us in some respects and as a result he reduced the space requirements for the new mint by 35,000 square feet. This reduction was made primarily by the elimination of space for a proof-coining operation which Bureau officials agreed may not be required. The result of this reduction in space is a decrease of about \$2 million in the base cost estimate for the building. The cost impact is increased as the various add-on factors are applied.

The deletion of 35,000 square feet results in a total space requirement of 415,000 square feet; however, exact sizing of the facility is not and will not be decided until design is completed. The design phase may add to or subtract from this total and the cost estimate will increase or decrease accordingly. The Bureau has recently received the results of a study it contracted for the Philadelphia Mint, which provides equipment-spacing requirements for the production of 10 billion coins annually. Comparison of space requirements in this study and those proposed for the new Denver Mint indicates possible oversizing in the new facility.

The purpose of this type of estimate is to formulate a request for authorization of a project. It is a preliminary or budget estimate and is not based on finalized design. The cost estimate for the new Denver Mint was initially prepared in 1973 and updated in 1975. There have been modifications in the scope of the project since these estimates were developed which makes them outdated. There are also indications that costs and sizing of the proposed facility may be overstated.

The Bureau should reevaluate its space requirements for a new Denver Mint. This will require the development of a new cost estimate by Treasury and GSA. This estimate should be prepared in accordance with suggested guidelines in the General Services Administration's Cost Estimating Handbook and should not be based on historical construction costs of the Philadelphia Mint.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

The Secretary of the Treasury is charged by the Congress with responsibility for making adequate numbers of coins to meet national needs. The Bureau of the Mint, established to manufacture coins, now has a coinmaking capacity of about 18.1 billion coins in three production facilities. In fiscal year 1975 it produced about 13.1 billion coins to meet demands.

The Bureau is currently seeking congressional approval for expanding current coinmaking capacity by building a new Denver Mint at a cost of \$65 million. The new mint is being justified on the basis that increasing demand for coins, estimated to reach 18 billion coins by 1980, will leave practically no margin for error in coin requirement forecasting and no reserve capacity to meet coin requirements beyond 1980.

We found that the Bureau had four different models available for forecasting future coin requirements. Depending on the assumptions used in these models, 1990 coin requirements range from 17 to 50 billion coins. These different projections were not made available to the Committee.

A current Bureau study projects 1990 coin requirements to range from between 26 to 64 billion coins. The study projects the most likely estimate to be about 41.5 billion coins; of that total about 91 percent or 37.6 billion coins are cents.

We believe that a previously developed Bureau coin-forecasting model, using updated information, offers a reasonable alternative to the current Bureau study's 1990 coin requirement projections. This alternative projection amounts to about 28.8 billion coins. However, either projection is significantly higher than the Bureau's current coinmaking capacity.

Adding to the uncertainty of the coinage demand projections is the possibility of changes to the coinage system, particularly to the cent coin. Rising costs of labor and material threaten to make the copper cent obsolete. Further, the cost of manufacture and distribution, the high annual attrition being experienced with the cent, and the steady declining purchase value of the cent, make it likely the coin, regardless of its material content, will become

too costly within the next few years. If the cent is dropped from the coinage system, metal composition is changed, or some other change is made (such as adding a 2-cent coin), coin demand will be significantly changed.

Because of the uncertainty of future requirements, we believe alternatives other than constructing a new, larger mint must be explored to prevent a large expenditure for a new plant which may not be needed or which may be needed for only a limited time. We believe there are alternatives available which the Bureau of the Mint can use to supply higher coin demand if it does occur. These alternatives include

- using all existing production facilities, including the San Francisco Assay Office;
- combining medal and proof coin operations and using saved space to increase production capability;
- upgrading West Point equipment to increase productivity;
- modifying the production area in the Philadelphia Mint to achieve increased production;
- eliminating strip production capability and converting the space to coin production;
- purchasing cent blanks and replacing the blanking presses with coin presses; and
- building inventories of cent coins when capacity exceeds demand to fulfill future demand when it exceeds capacity.

All of these alternatives can be implemented in relatively short leadtimes compared to the time required to design and construct a new mint, which the Bureau estimates to be 4 years.

While we believe there is presently no need to construct a new mint at Denver because of future coin demand, we did look at the physical condition of the current Denver Mint to see if it should be replaced. The officials at the mint have had some engineering tests made on the structure and have found no problems with structural weakness. There are problems with noise levels exceeding desirable limits and the production area is congested with crowded work areas and awkward material flow. A comparison of available space to the Philadelphia coin production area indicates the Denver

Mint should probably reduce its equipment to allow more space and alleviate the excessive noise. While this change could result in loss of some production capacity, it would provide safer, healthier work surroundings for employees.

The cost estimate of \$65 million presented to the Congress with the request to authorize construction of a new mint at Denver is probably overstated. The basic building cost was estimated using the new Philadelphia Mint construction cost as a base. The Philadelphia Mint had, however, several high-cost features which would probably not be required of the Denver Mint construction. Further, the estimated size of the proposed new Denver Mint is overstated by including space that will not be required. The estimate also includes escalation allowances for inflation which overlap the base construction period and are therefore probably overstated.

The construction cost estimate was originally prepared in 1973 when another construction site was being considered. It was updated to reflect some changed conditions, but was not completely reworked as it perhaps should have been.

RECOMMENDATIONS

We recommend to the Secretary of the Treasury that he require the Bureau of the Mint to make a comprehensive study of the various options for increasing production within the Bureau's present facilities, including those options we have presented in this report. The study should result in a plan of implementation to correspond to anticipated future demand. Constant review of coin demand trends will be necessary to keep this plan current.

Since it appears possible that in the future copper prices, manufacturing and distribution costs, and cent attrition rates may rise to a level making the copper cent no longer usable, contingency plans should be developed on what action to take when these increases do occur. We recommend that the Secretary of the Treasury require the Bureau to prepare such contingency plans and also make recommendations concerning the introduction of an intermediate coin, such as a 2-cent coin, to reduce demand for the cent coin. Possible changes to the coinage system also need to be considered in planning for production capacity changes.

We also recommend that the Secretary require the Bureau to study the production facility at Denver and to develop capacity and material flow procedures that will best utilize the space available at this facility and provide safer, healthier working conditions for the mint employees.

AGENCY COMMENTS

On October 14, 1976, the Deputy Assistant Secretary of the Treasury (Operations) furnished comments on this report. (See app. IV.)

The Department of the Treasury stated that a decision needs to be made regarding the future of the existing U.S. coinage system especially as it pertains to the cent. The Department intends to obtain wide public reaction to the possible elimination of the cent before making a decision.

The Department stated that if a decision is made to eliminate the cent coin, a new Denver Mint is not required, and no further action will be taken by the Department on a new mint. However, if the decision is to continue cent production to 1985 and beyond, the Department intends to seek increased, permanent cost-effective production capacity.

The Department believes that the options we outlined to increase the Bureau of the Mint's coinmaking capacity need more examination and refinement as to the increased production they would actually yield and the practicality and cost of implementation. The Bureau of the Mint has started this examination.

The Department believes that the Congress should act favorably on the authorization request for the new mint while it considers the future of the U.S. coinage system and the Bureau of the Mint examines the practicality and the cost of all the options available for increasing its current coinmaking capacity. The Department believes this would provide flexibility by allowing it to proceed on the project should that prove to be the most cost-effective solution. The Department states that the Congress could still retain control over the project through the appropriation review process.

We believe that in light of the uncertainty associated with projecting coin requirements, the possible changes in the coinage system, the moderate increases in production capacity that can be implemented, and the possible increased reliance on contractors, a sizable capital expenditure at this time would be premature.

COPY

BUREAU OF THE MINT COINFORECASTING MODELS (note a)

1. The A. D. Little 1/ Approach: An indirect correlation between cent demand and time was used. In the study completed in 1963 by A. D. Little Company, correlation was shown between time and a mathematical model of coin demand which contained the following variables: cents in circulation, rate of growth of cents in circulation, rate of loss of cents from circulation. A. D. Little considered and rejected correlations between cent demand and various economic variables. Variables considered were sales taxes, vending machine sales, and gross national product. There were two reasons for not using economic variables. First, correlation between them and cent demand appeared no better than correlation with time and, second, the variables themselves were hard to forecast, especially at long-range. A. D. Little employed a very long time-frame (1900-1962). Over the period, cent demand was increasing at 6.8 percent annually. Over the period 1947-1962, A. D. Little found that it had been increasing at 10.2 percent per year. 2/

2. The Morrison 3/ Approach: An indirect correlation between cent demand and economic variables was used. Multiple regression analysis in 1967 produced coefficients for correlating cents in circulation directly and coin demand indirectly with the following parameters: retail sales, sales taxes, consumer price index, and personal consumption expenditures. Coin intensive industry revenues and availability of half dollars were found not to correlate.

3. The Hunter 4/ - Friedman 5/ Approach: Cent demand and time were correlated directly. This was a simple extrapolation of historic demand at historic growth rate over the period 1950 to 1972-3. Hunter used semilogarithmic graph paper; Friedman used linear regression analysis. Friedman forecasted cent demand. Hunter forecasted both cent and total coin demand, excluding the mid-sixties data for total coin demand because of the replacement of silver coins during that period.

a/ "One Cent Coinage, A Summary of the 1973-1974 Treasury-Federal Reserve Committee Studies," Department of the Treasury, October, 1974.

4. The Hunter-DeLeo Approach: An indirect correlation between total coin demand and time. Demand for all denominations combined (or for any one denomination of interest) can be correlated with a simple mathematical model involving the following variables: demand for cents, and the ratio of demand for cents to demand for all denominations (or to any one denomination of interest). All calculations have assumed that cent demand will comprise a steady 75 percent of total coin demand. Thus, estimated total coin demand equals the estimated cent demand divided by 0.75.

References

1. "Production Facilities for the United States Mint," A. D. Little, Inc. Final Report to the Director of the Bureau of the Budget, February 11, 1963, pp. 21-4, Table B-V.
2. "Working Memorandum No. 7," A. D. Little Report, Case 64904, October 31, 1962, p. 3.
3. "Coin in Circulation," George R. Morrison, Consultant to the Office of Planning and Program Evaluation, Office of the Secretary of the Treasury, June, 1957, pp. 43-56.
4. "Long Range Coin Demand," George E. Hunter, Memorandum to Assistant Director for Technology, Bureau of the Mint, February 8, 1973.
4. "Projection of the Demand for 1¢ Coins," Charles Friedman, Office of Planning and Evaluation, Office of the Secretary of the Treasury, January 16, 1974.

PRODUCTION AND ACTUALDEMAND FOR CENT COINS

<u>Fiscal</u> <u>year</u>	<u>Production</u>	<u>Actual</u> <u>demand</u> <u>(note a)</u>	<u>Production</u> <u>over or</u> <u>under(-)</u>
------(000,000 omitted)-----			
1954	835	548	287
1955	605	738	-133
1956	1,207	1,253	-46
1957	1,385	1,294	91
1958	1,401	931	470
1959	1,126	1,542	-416
1960	1,981	2,295	-314
1961	2,459	2,256	203
1962	2,545	2,556	-11
1963	2,558	2,559	-1
1964	2,675	2,854	-179
1965	3,715	2,863	852
1966	2,803	3,326	-523
1967	3,617	3,337	280
1968	3,746	4,035	-289
1969	5,345	5,284	61
1970	5,563	5,241	322
1971	5,304	5,298	6
1972	6,201	5,603	598
1973	6,392	6,665	-273
1974	8,354	8,595	-241
1975	10,005	9,422	583
1976	9,210	7,587	1,623

a/Net payout of cents by Federal Reserve Banks was used as an indicator of cent demand since historical data on actual demand for cents was not available.

RESEARCH TRIANGLE INSTITUTE PROJECTIONS OF
ANNUAL COIN REQUIREMENTS (note a)

<u>Year</u>	<u>Present mix</u> <u>(note b)</u>		<u>Option 1</u> <u>(note c)</u>		<u>Option 2</u> <u>(note d)</u>		<u>Option 3</u> <u>(note e)</u>		<u>Total</u>
	<u>Cent</u>	<u>Total</u>	<u>Cent</u>	<u>Total</u>	<u>Cent</u>	<u>Total</u>	<u>Cent</u>	<u>Two Cent</u>	
------(billions)-----									
1978	12.7	15.3	17.9	20.5	6.0	10.3	4.0	6.0	12.6
1979	14.1	16.8	19.6	22.3	0	4.5	4.0	6.9	13.6
1980	15.6	18.4	20.1	22.9	0	4.6	4.0	7.6	14.4
1981	17.0	19.9	27.6	30.6	0	4.8	4.0	8.5	15.4
1982	19.0	22.0	25.1	28.1	0	5.0	4.0	9.0	16.1
1983	20.5	23.7	28.8	32.0	0	5.2	4.0	10.3	17.5
1984	22.0	25.3	24.9	28.2	0	5.4	4.0	10.9	18.2
1985	24.9	28.2	28.1	31.5	0	5.6	4.0	11.7	19.1
1986	26.0	29.5	31.3	34.8	0	5.7	4.0	13.4	20.9
1987	29.5	33.1	33.0	36.6	0	5.9	4.0	13.6	21.2
1988	32.0	35.7	37.6	41.3	0	6.1	6.1	14.6	24.4
1989	35.0	38.8	40.9	44.7	0	6.1	8.1	14.7	26.6
1990	37.6	41.5	45.1	49.0	0	6.3	9.1	15.9	28.9
Total	305.9	348.2	380.0	422.5	6.0	75.5	63.3	143.1	248.9

a/The various alternatives presented are based on the same data used by RTI to compute its estimate of coin requirements as previously discussed beginning on page 9.

b/Includes the 95-percent copper - 5-percent zinc cent.

c/Change the composition of the cent to aluminum.

d/Eliminate the cent.

e/Introduce a 2-cent coin to cocirculate with the cent.



DEPUTY ASSISTANT SECRETARY

DEPARTMENT OF THE TREASURY
WASHINGTON, D.C. 20220

OCT 14 1976

Dear Mr. Lowe:

We appreciate the opportunity to comment on your draft report entitled "Review of the Need for a New Denver Mint," GAO assignment code number 947229, which was forwarded to the Secretary of the Treasury by your letter of September 16, 1976. The Treasury Department values having the benefit of the study and analysis performed by the GAO team, although it believes some of the findings should be corrected and some of the action recommendations modified.

The principal conclusion of the report is that various operating changes within existing facilities would enable the Mint to meet "realistic" coinage requirements without construction of a new mint. Before this can become a basis for an operational decision by the Bureau of the Mint, we believe two aspects need more thorough analysis.

First, as the GAO report recognizes, the primary mission of the Bureau of the Mint is to produce the media of exchange required to support the commercial activities of the people of the United States. Since a shortage of coins would seriously inhibit these commercial activities, the Mint must plan to maintain sufficient coinage capacity to provide an additional reserve capability to cover the eventuality of the higher ranges of forecast demand. The need for this conservative approach is accentuated by the long lead time required to obtain Congressional authorization and appropriations, and then to design, construct and equip new plant capacity.

As discussed in your report, we are, indeed, faced at this time with a dilemma regarding the penny. If a decision is made by the Congress to eliminate the penny and adopt the nickel as the lowest denomination within a relatively short time frame, then a new Denver Mint is not needed. The Treasury intends to obtain wider public reaction to such a proposal, complete analysis of the various alternatives and arrive at recommended changes, if any, to present to the next Congress. However, public resistance to change may preclude elimination of the penny. Therefore, pending a definitive determination, the only prudent course is to proceed with all steps short of obligation of funds to ensure adequate production capacity for the 1980's.

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The GAO report contains considerable discussion pertaining to the matter of forecasting coinage demand. However, both the General Accounting Office and this office agree that forecasting future requirements cannot be done with complete certainty and that by 1980 demand will exceed the current production capacity of the Bureau of the Mint as presently operated.

This leads to the second major consideration. The report proposes eight changes in operation of the mints which allegedly would increase the production capacity of present facilities. Without question, existing facilities should be fully utilized before embarking on major construction and equipment programs. Indeed, the Mint has for some time been following this approach, sometimes requiring improvisation, in order to keep capacity ahead of demand. For the long term, however, total cost-effectiveness of both capital expenditures and operating efficiency is of paramount importance when conducting "expansion vs. new facility" trade-offs. The changes recommended by GAO need more examination and refinement, both as to the increased production they would actually yield and the practicality and cost of implementation. Among the costs needing exploration are the diminished operating efficiencies from overcrowding, the personnel costs from failure to meet OSHA standards, and the potential increase in materials costs from elimination of the gauge of an in-house strip production operation. The Bureau of the Mint will thoroughly analyze and consider the validity of the changes recommended by GAO from the viewpoint of total long-term effectiveness.

The enclosed comments cover factual corrections (Enclosure 1) and present more detailed observations and preliminary findings on the various chapters of the GAO report (Enclosure 2).

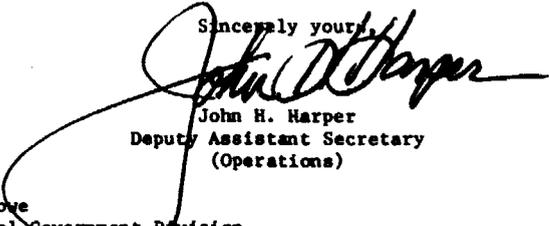
[See GAO note 1, p. 46.]

In conclusion, we believe we are approaching the time for decisions which will impact the U.S. coinage system significantly. If the decision is for no more penny production, a new Denver Mint is not required, and no further action will be taken by the Department on this project. If the decision is to continue penny production to 1985 and beyond, we must proceed to implement permanent cost-effective capacity to meet projected demand. We believe Congress should act favorably on our authorization request for the new mint. This would provide flexibility by allowing us to proceed expeditiously on the project should it prove to be the most cost-effective solution. At the same time, the Congress would retain control over the project through the appropriation request review process.

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After reviewing our reply to your draft report, should you desire further amplification or discussion, please contact my office. We look forward to receiving a copy of your final report.

Sincerely yours,



John H. Harper
Deputy Assistant Secretary
(Operations)

Mr. Victor L. Love
Director, General Government Division
U.S. General Accounting Office
Washington, DC 20548

Enclosures

GAO Note:

1. Enclosures 1 and 2 have been omitted, but the comments have been considered where appropriate.

PRINCIPAL OFFICIALS OF
THE DEPARTMENT OF THE TREASURY
RESPONSIBLE FOR ADMINISTERING THE ACTIVITIES
DISCUSSED IN THIS REPORT

	<u>Tenure of office</u>	
	<u>From</u>	<u>To</u>
SECRETARY OF THE TREASURY:		
William E. Simon	May 1974	Present
George B. Shultz	June 1972	May 1974
John B. Connally	Feb. 1971	June 1972
David M. Kennedy	Jan. 1961	Feb. 1971
DIRECTOR, BUREAU OF THE MINT:		
Mary T. Brooks	Sept. 1969	Present